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(54) **MEASURING TAPE RULE DEVICE**

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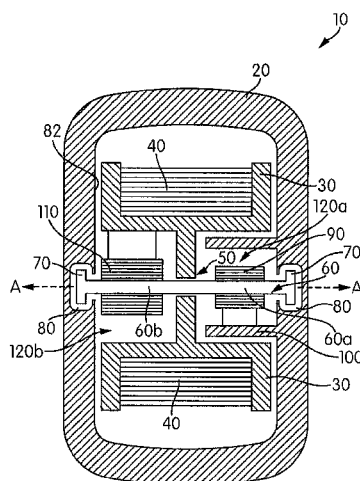
USPC 33/754, 755

See application file for complete search history.

(57) **ABSTRACT**

A measuring tape rule device includes a tape rule housing, the housing having a connection portion. The device also includes an axle within the housing, the axle configured to rotate about an axis of rotation. The device also includes a reel within the housing, the reel configured to rotate about the axis of rotation and the axle. The device additionally includes an elongated tape having gradations thereon and wound on the reel. The device further includes a first spring coupled between the axle and the connection portion of the housing, and a second spring coupled between the axle and the reel. Rotation of the reel relative to the housing in a direction tending to tension the second spring transmits rotational movement to the axle through the tensioning of the second spring. Such rotational movement of the axle is applied to the first spring to tension the first spring.

33 Claims, 3 Drawing Sheets



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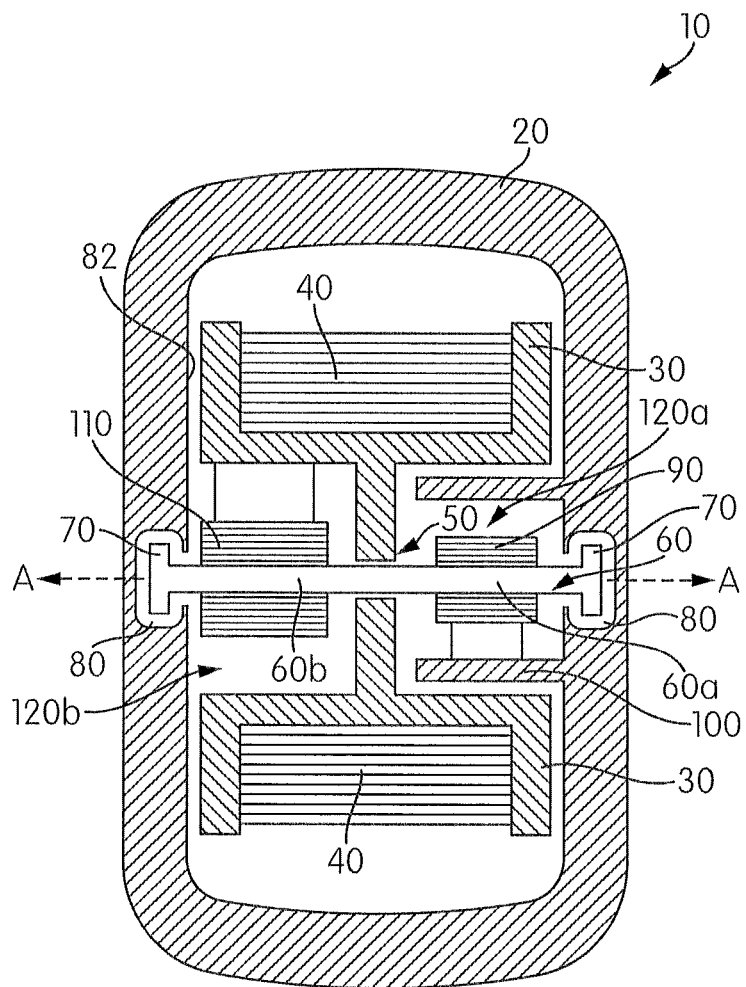


FIG. 1

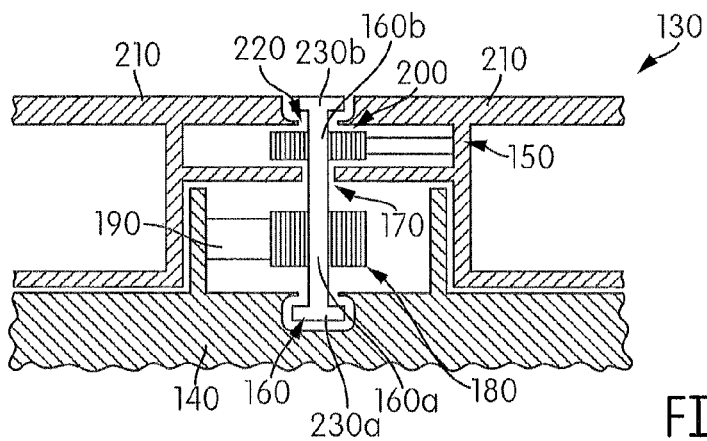


FIG. 2

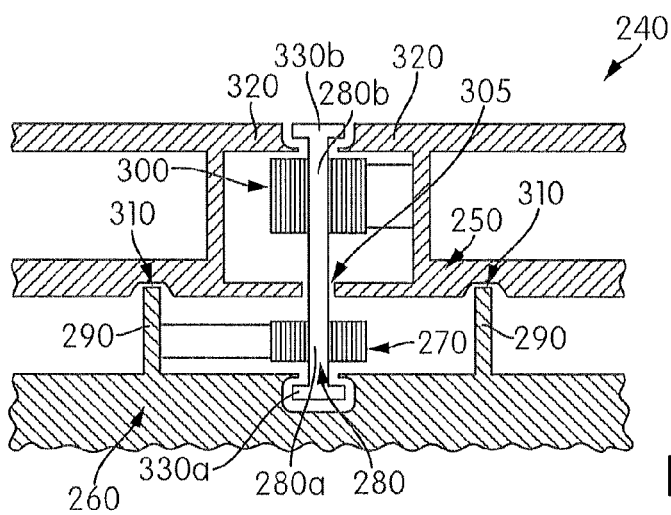


FIG. 3

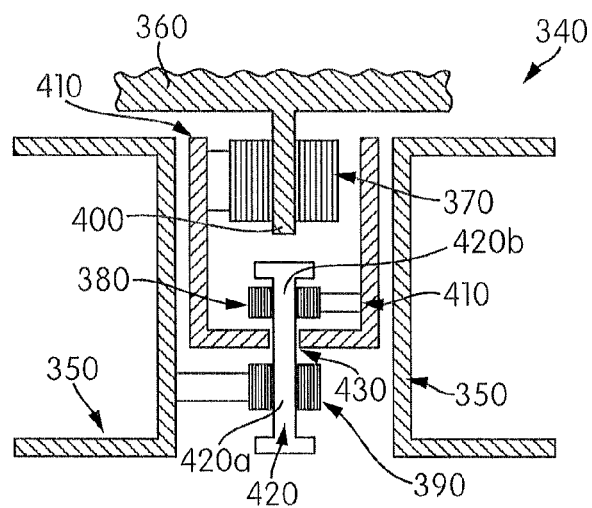


FIG. 4

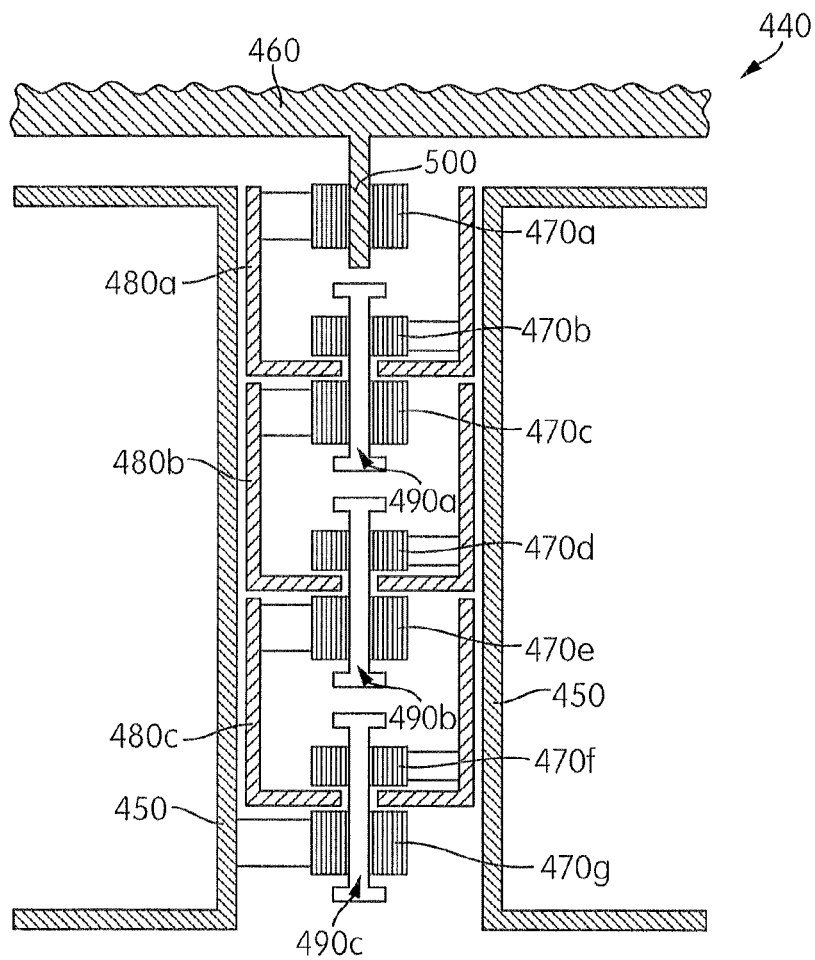


FIG. 5

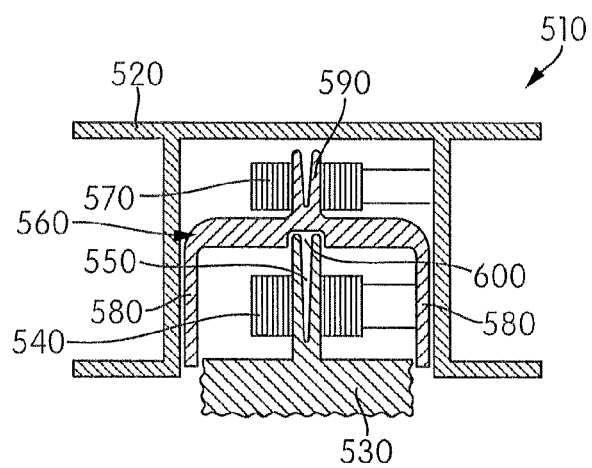


FIG. 6

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MEASURING TAPE RULE DEVICE

This application claims priority and benefit under 35 U.S.C. §119(e) to U.S. Provisional Patent Application Ser. No. 61/703,062, filed Sep. 19, 2012. The content of that application is incorporated herein in its entirety by reference.

FIELD OF THE INVENTION

The present invention relates generally to measuring tape rule devices.

BACKGROUND OF THE INVENTION

Tape measures are often configured to receive a length of windable material having measuring gradations thereon, wound around a reel, so as to store the material in a compact form. The windable material may be unwound from the reel, for use thereof. While the windable material is generally in the form of a thin metal tape (including but not limited to a blade or measuring tape), other windable materials including measuring gradations may alternatively be utilized including but not limited to composite, or any other appropriate material). Accordingly, while such devices are commonly known in the art as “tape measures,” or “measuring tape rule devices,” it may be appreciated that while the windable material with gradations utilized therein may be referred to as “tape,” the material of the tape can be varied. While some tape measures are configured to be manually wound, other tape measures are configured as retractable, with a spring bias configured to wind the windable material into the tape measure. An example of this latter configuration of tape measure may be found in U.S. Pat. No. 6,643,947, incorporated herein by reference in its entirety.

In some tape rule devices, to support a spring torque that facilitates complete retraction, the spring may occupy more space (e.g., it may be wider or longer) than what is desired.

In some other tape measures, to ensure complete retraction of the windable material therein, the spring may require a large torque profile, which may overcome friction of the windable material as it winds onto the reel. For example, some windable materials of tape measures may generally have a concave configuration, so as to resist deformation along a length of the windable material as it is extended from the reel. As the windable material is further wound around the reel, the concave configuration in interior windings of the windable material may flatten due to the force applied from exterior windings of the windable material. Such flattening of the otherwise concave configuration may further cause frictional resistance to winding or unwinding the windable material. The longer the windable material extraction from a stored state, the more progressive the torque demand to retract the windable material around the reel, and the greater the spring torque profile required to ensure complete retraction. It may be appreciated that excessive spring torque beyond that required to overcome frictional resistance of the windable member may result in a higher retraction speed than what might be desired.

Among other things, the present application relates to an improved measuring tape design.

SUMMARY OF THE INVENTION

According to one aspect of this disclosure, a measuring tape rule device includes a tape rule housing, the housing having a connection portion. The device also includes an axle within the housing, the axle configured to rotate about an axis

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of rotation. The device also includes a reel within the housing, the reel configured to rotate about the axis of rotation and the axle. The device additionally includes an elongated tape having gradations thereon and wound on the reel. The device further includes a first spring coupled between the axle and the connection portion of the housing, and a second spring coupled between the axle and the reel. Rotation of the reel relative to the housing in a direction tending to tension the second spring transmits rotational movement to the axle through the tensioning of the second spring. Such rotational movement of the axle is applied to the first spring to tension the first spring.

According to another aspect of this disclosure, a measuring tape rule device includes a housing having an opening, the housing comprising a connection portion therein. The device also includes an axle within the housing, the axle being rotationally supported in the housing and configured to rotate about an axis of rotation. The device also includes a reel within the housing, the reel configured to rotate about the axis of rotation and the axle. The device also includes an elongated tape, the tape having measuring gradations thereon, the tape being wound on the reel and being extendable through the opening in the housing. The device further includes a first elongated spiral spring, the first elongated spiral spring having a first end portion and a second end portion, wherein the first end portion of the first elongated spiral spring is connected with the connection portion of the housing, and the second end portion of the first elongated spiral spring is connected with the axle. The device further still includes a second elongated spiral spring, the second elongated spiral spring having a first end portion and a second end portion, wherein the first end portion of the second elongated spiral spring is connected with the reel and the second end portion of the second elongated spiral spring is connected with the axle. Extension of the elongated tape through the opening in the housing rotates the reel in a first direction, wherein rotation of the reel in the first direction increases tension on the second elongated spiral spring, wherein increasing tension on the second elongated spiral spring imparts rotational movement of the axle in a first rotational direction, wherein rotational movement of the axle in the first rotational direction imparts increased tension on the first elongated spiral spring. Tension in the first elongated spiral spring and the second elongated spiral spring biases the reel in a second rotational direction that retracts the tape into the housing and winds the tape onto the reel.

According to another aspect of this disclosure, a reel assembly includes a housing, the housing having a connection portion. The reel assembly also includes an axle within the housing, the axle configured to rotate about an axis of rotation. The reel assembly additionally includes a reel within the housing, the reel configured to rotate about the axis of rotation and the axle. The reel assembly further includes a first spring coupled between the axle and the connection portion of the housing, and a second spring coupled between the axle and the reel. The second spring has a torque profile associated therewith different from a torque profile of the first spring. Rotation of the reel relative to the housing in a direction tending to tension the second spring transmits rotational movement to the axle through the tensioning of the second spring, and wherein such rotational movement of the axle is applied to the first spring to tension the first spring.

These and other objects, features, and characteristics of the present invention, as well as the methods of operation and functions of the related elements of structure and the combination of parts and economies of manufacture, will become more apparent upon consideration of the following descrip-

tion and the appended claims with reference to the accompanying drawings, all of which form a part of this specification, wherein like reference numerals designate corresponding parts in the various figures. In one embodiment of the invention, the structural components illustrated herein are drawn to scale. It is to be expressly understood, however, that the drawings are for the purpose of illustration and description only, and are not intended as a definition of the limits of the invention. In addition, it should be appreciated that structural features shown or described in any one embodiment herein can be used in other embodiments as well. As used in the specification and in the claims, the singular form of “a”, “an”, and “the” include plural referents unless the context clearly dictates otherwise.

BRIEF DESCRIPTION OF THE DRAWINGS

Features of the tape measure in accordance with one or more embodiments are shown in the drawings, in which like reference numerals designate like elements. The drawings form part of this original disclosure in which:

FIG. 1 is a cross-sectional view of an embodiment of a reel assembly of a tape measure of the present disclosure;

FIG. 2 illustrates a cross-sectional view of another embodiment of a reel assembly of a tape measure of the present disclosure;

FIG. 3 illustrates a cross-sectional view of another embodiment of a reel assembly of a tape measure of the present disclosure;

FIG. 4 illustrates a cross-sectional view of another embodiment of a reel assembly of a tape measure of the present disclosure;

FIG. 5 illustrates a cross-sectional view of another embodiment of a reel assembly of a tape measure of the present disclosure; and

FIG. 6 illustrates a cross-sectional view of another embodiment of a reel assembly of a tape measure of the present disclosure.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENT(S)

FIG. 1 illustrates a cross sectional view of a reel assembly 10 of a tape measure of the present disclosure. The reel assembly 10 includes a housing 20 configured to support a rotatable reel 30 therein. It may be appreciated that a tape or windable member 40 may be wound around the reel 30. The windable member 40 may be of any appropriate construction or configuration. Accordingly, as used herein, the term “tape” or “windable material” can refer to a variety of different constructions or materials that are arranged to carry or display gradations that have been applied to a surface thereof, by any appropriate manner. In various embodiments, the gradations may be applied to the surface of the tape or windable material by paint, etching, stenciling, combinations thereof, or through other applicable processes. In some embodiments the housing 20 may enclose the reel 30 (e.g., substantially surrounds the reel 30). Such enclosure of the reel 30 by the housing 20, may be such that the windable member 40 is retractable from the reel 30 (and thus the housing 20). For example, in an embodiment the housing 20 may include an opening through which the windable member 40 can be extended outside the housing 20. Conventionally tape measures have such an opening, so the windable member (i.e., the tape) thereof may be pulled from a portion extending from the opening (e.g., a tape hook coupled to the windable member), to extend the windable member from the housing. An

example of such a tape measure is disclosed in U.S. patent application Ser. No. 13/368,756, incorporated herein by reference in its entirety). The windable member 40 of the reel assembly 10 may be of any appropriate construction or configuration, including but not limited to being a tape, or a cable, having measurement gradations thereon. Likewise the housing 20 may be of any appropriate construction or configuration. For example, in an embodiment the housing 20 may be formed from metal, plastic, or any other appropriate material, and may be integrally formed or may comprise an assembly. For example, in an embodiment the housing 20 may be formed from clamshell halves or other discrete components that are secured together to surround the reel 30 (and the windable member 40 when wound around the reel 30). Such securing together of the components of the housing 20 may be by any appropriate mechanism, including but not limited to being secured by fasteners, snap fitting together, being adhered or otherwise fused together, or so on.

As shown, the reel 30 may contain an aperture 50 therein, and through which a rotatable axle 60 may extend through. The rotatable axle 60 may extend along an axis of rotation (axis “A”) common to the reel 30 and the rotatable axle 60. As shown, in the embodiment of FIG. 1, the rotatable axle 60 may include one or more connection portions 70. In the shown embodiment, the connection portions 70 are on both opposite end portions of the rotatable axle 60. In another embodiment, it is contemplated that only one end of the rotatable axle 60 need be provided with a connection portion 70. The connection portion 70 enables the rotatable axle 60 to be rotatably coupled to the housing 20. In the illustrated embodiment, the connection portions 70 are in the form of flanged portions that are received in corresponding receptacles 80 in the interior surface 82 of the housing 20. It may be appreciated that the flanged portions 70 being received in the receptacles 80 may prevent or constrain undesired movement or displacement between the reel 30 and the rotatable axle 60 relative to the housing 20, while allowing for rotation of both within the housing 20.

Coupling the rotatable axle 60 to the housing 20 is a first spring 90. As shown, the first spring 90 may have one end portion thereof connected to a first side 60a of the rotatable axle 60, and an opposite end portion thereof connected to a connection portion 100 fixed relative to the housing 20. In some embodiments, such as that illustrated, the connection portion 100 may be integrally formed with the housing 20. Other configurations are alternatively possible. For example, connector portion 100 may be a separately formed structure that is connected, fastened, or joined to the interior surface 82 of the housing 20. In an embodiment, the first spring 90 may comprise a flat spiral spring, which may be wound around the first side 60a of the rotatable axle 60, with one end secured to the first side 60a, and the opposite end secured to the connection portion 100. In an embodiment, the flat spiral spring, or other configurations of the first spring 90, may comprise spring steel. It may be appreciated that other configurations of the first spring 90 are alternatively possible.

The reel assembly 10 further includes a second spring 110 coupled between the rotatable axle 60 and the reel 30. Specifically, the second spring 110 may have one end portion thereof connected to a second side 60b of the rotatable axle 60, and the opposite end portion thereof connected to the reel 30. As shown in the illustrated embodiment, the second spring 110 may comprise a flat spiral spring which may be wound around the second side 60b of the rotatable axle 60, with one end secured to the second side 60b, and the opposite end secured to the reel 30.

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In an embodiment, the first spring **90** has a first end (outer end) connected to the connection portion **100**, and a second end (inner end) connected to the rotatable axle **60**. The first spring **90** is wound counterclockwise from the outside connection to the inside connection when viewed from the right side of FIG. **1** (viewed along the axis **A**). The second spring **110** has a first end (outer end) connected to the reel **30** and its second end (inner end) connected with the axle. The spring **110** is wound clockwise from the outside connection to the inside connection when viewed from the right side of FIG. **1** (viewing along the axis **A**).

In an embodiment, the second spring **110** has a lower spring constant (k) so as to apply a lower winding force than the first spring **90**, which has a greater spring constant (k). In other embodiments, however, the second spring **110** may have a greater spring constant (k) than the first spring **90**. Such a configuration may be utilized because the springs are coupled in series, so the weaker spring, having a lower spring constant (k), will unwind before the stronger spring having a greater spring constant (k), in embodiments where the two spring constants differ.

It may be appreciated that the first spring **90** and the second spring **110** may be coupled to one another, to the reel **30**, and to the housing **20** (through the connection portion **100**) in such a manner so as to transfer turns of the reel **30** from one spring to the other. For example, the first spring **90** may be wound around the rotatable axle **60** in an opposite direction to the second spring **110**. Such a coupling allows the reel assembly **10** to store turns on both the first spring **90** and the second spring **110**, where available potential turns for the reel **30** is through a combination of turns on each of the first spring **90** and the second spring **110**. It may be appreciated that by linking the first spring **90** and the second spring **110** in this manner, the reel assembly **10** may be formed in a compact arrangement. For example, in one embodiment, a diameter of first and second spring chambers **120a** and **120b** of the reel assembly **10** (i.e., the spaces of the reel assembly **10** where the first spring **90** and second spring **110** respectively reside) may be smaller than a comparable spring chamber housing a single larger spring wound therein to maintain the same amount of potential energy for retracting the windable member **40**. This may be accomplished because the first spring **90** and the second spring **110** may each have a smaller diameter, and be positioned alongside one another (e.g., sharing a common axis), facilitating a housing **20** having spring chambers that are defined by the smaller diameter of each of the first spring **90** and the second spring **110**, while a single larger spring would necessitate a single larger spring chamber defined by the larger diameter of the larger spring.

In the illustrated embodiment the spring chambers **120a** and **120b** are positioned within the reel **30**, and thus the springs **90** and **110** are themselves located within the reel **30**. Specifically, the first spring chamber **120a** is defined by a side of the reel **30** surrounding the first side **60a** of the rotatable axle **60**, while the second spring chamber **120b** is defined by a side of the reel **30** surrounding the second side **60b** of the rotatable axle **60**. While in the illustrated embodiment the first spring chamber **120a** and the second spring chamber **120b** are positioned entirely within the reel **30**, in other embodiments, spring chambers associated with the first spring **90** and/or the second spring **110** may be located elsewhere in the reel assembly **10**. For example, the first spring **90** and/or the second spring **110** may be located completely within, partially within, or outside of a volume defined by the extremities of the reel **30**.

In some embodiments, the spring chambers **120a** and **120b** may be sized based on the spring therein. For example, in an

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embodiment where each of the spring chambers **120a** and **120b** are defined by the reel **30**, the spring chambers **120a** and **120b** may be sized based on the first spring **90** and/or the second spring **110**. While in some embodiments the first spring **90** and the second spring **110** may be of similar construction or configuration (albeit with opposite direction of winding in the illustrated embodiment), in other embodiments, the first spring **90** and the second spring **110** may have different characteristics from one another, depending on a desired performance over a cycle of retraction. For example, the material, torque profile, thickness, hardness, and width of the flat configuration of spring may differ from the first spring **90** and the second spring **110**. As described in greater detail below, such varied configuration may facilitate a faster retraction of the windable member **40** during the initial retraction, however a slower retraction of the windable member **40** thereafter. For example, where the windable member **40** is terminated by a hook (e.g., a tape hook on a measuring tape blade), a slower subsequent retraction may reduce an amount of force placed on the hook when the hook engages the housing **20** to prevent further retraction.

During operation of the reel assembly **10**, it may be appreciated that as the reel **30** is turned (e.g., when extending the windable member **40**), the second spring **110** is tensioned from the exterior of the diameter of the second spring **110** (e.g., pulling from the outside end of the second spring **110** to tension the second spring **110**), which in turn drives the rotatable axle **60** in the same rotational direction as the reel **30**. This movement of the rotatable axle **60** is thus transferred to the first spring **90**, tensioning the first spring **90** around the rotatable axle **60** from the interior of the diameter of the first spring **90** (e.g., pulling from the inside end of the first spring **90** to tension the first spring **90**). The reel assembly **10** therefore stores rotations of the reel **30** on both the first spring **90** and the second spring **110** as the windable member **40** is extended. When the windable member **40** is released, the reel **30** and rotatable axle **60** of the reel assembly **10** would spin under the force of the first spring **90** and the second spring **110**, retracting the windable member **40** to be wound around the reel **30**.

In some embodiments, the reel may be configured to be supported alongside the housing. For example, FIG. **2** illustrates an embodiment of a reel assembly **130** comprising a housing **140** configured to support a reel **150** alongside the housing **140**. Similarly to the reel assembly **10**, the reel assembly **130** includes a rotatable axle **160** configured for rotation relative to the housing **140**. Specifically, the rotatable axle **160** may extend through an aperture **170** formed in the reel **150**. Additionally, a first spring **180** couples a first side **160a** of the rotatable axle **160** to a connection member **190** fixed relative to the housing **140**. The connection member **190** may be generally similar to the connection portion **100** of the reel assembly **10**, and accordingly, may be formed integrally to the housing **140**, or may be otherwise secured thereto. As second spring **200**, analogous to the second spring **110** of the reel assembly **10**, may be coupled between a second side **160b** of the rotatable axle **160** and the reel **150**. As shown, in an embodiment the reel **150** may be held adjacent to the housing **140** by the rotatable axle **160**. Specifically, in the illustrated embodiment, the reel **150** may include axle engaging portion **210**, with an aperture **220** therein configured to receive the rotatable axle **160**. As shown, each end of the rotatable axle **160** may include flanged portions **230** (e.g., flanged portion **230a** associated with the first side **160a** and flanged portion **230b** associated with the second side **160b**). Accordingly, engagement between the flanged portion **230b** of the rotatable axle **160** and the smaller diameter of the aperture **220** may

limit movement of the reel **150** away from the rotatable axle **160**. Additionally, engagement between the flanged portion **230a** of the rotatable axle **160** and the housing **140**, such as that shown, may limit movement of the reel **150** (and the rotatable axle **160**) away from the housing **140**. Other mechanisms to support the reel **150** adjacent to the housing **140** are alternatively possible in other embodiments.

As indicated above, in various embodiments one or more of the springs may be positioned outside of the volume defined by the reel. For example, FIG. 3, illustrates an embodiment of a reel assembly **240** comprising a reel **250** configured to be supported alongside a housing **260**. As shown, in the illustrated embodiment, the reel **250** may be shaped so that a first spring **270** configured to couple a rotatable axle **280** to the housing **260** (e.g., via a connection member **290**). As shown, the connection of the first spring **270** may be through a first side **280a** of the rotatable axle **280**. A second spring **300** may accordingly be coupled between a second side **280b** of the rotatable axle **280** and the reel **250**. As shown, the rotatable axle **280** may extend through an aperture **305** formed in the reel **250**. As shown, the connection member **290** may be configured to engage a groove **310** formed in the reel **250**, so as to limit pivotal motion between the reel **250** and the housing **260**. While in some embodiments the connection member **290** may have a post-configuration, in other embodiments, such as that illustrated, the connection member **290** may have an annulus configuration, so as to provide at least two areas of contact between the groove **310** of the reel **250** and connection member **290**. It may be appreciated that in embodiments where the connection member **290** includes a post-configuration a second post may be positioned spaced from the connection member **290**, configured to additionally engage the groove **310** of the reel **250**, so as to further limit pivotal movement of the reel **250** at the rotatable axle **280**. In the illustrated embodiment it may be appreciated that the reel **250** engages the rotatable axle **280** at an axle engaging portion **320**, similar to the axle engaging portion **210** described above (e.g., by engaging a flanged portion **330b** associated with the second side **280b** of the rotatable axle **280**). It may be appreciated that a flanged portion **330a** associated with the first side **280a** of the rotatable axle **280** may engage the housing **260** in a manner that prevents movement of the reel **250** and the rotatable axle **280** away from the housing **260**, or the reel **250** may be prevented from moving away from the housing **260** by any other appropriate mechanism.

In some embodiments, additional springs may be utilized in the reel assembly so as to further modify the retraction. In an embodiment, the additional springs may be configured to allow for longer lengths of retraction without increasing a diameter of the reel assembly. For example, FIG. 4 illustrates an embodiment of a reel assembly **340** having a reel **350** configured for rotation relative to a housing **360**. As shown, the reel assembly **340** includes a first spring **370**, a second spring **380** and a third spring **390**. The first spring **370** is coupled to the housing **360** via a connection member **400**. As in embodiments above, the connection member **400** may alternatively be integrally formed with the housing **360**, or may otherwise be secured thereto. The first spring **370** is also coupled to an intermediate member **410**, which further couples the first spring **370** to the second spring **380**. In any of the embodiments, the connections of the ends of the springs can be direct to the remaining structure of the reel assembly (e.g., the reel, axle, and/or housing), or may be indirect, through any intermediate securement. As shown in the illustrated embodiment, the intermediate member **410** may be formed as a cup or other member configured for rotation about an axis of rotation for the reel **350**. In an embodiment,

the intermediate member **410** may comprise an annular configuration, or other configuration which may receive a spring between the intermediate member **410** and a rotatable axle **420**, encircling the spring as the intermediate member **410** rotates about the axis of rotation. In some embodiments, the intermediate member **410** may be configured to physically separate the first spring **370** and/or the second spring **380** from the reel **350**, which may prevent frictional engagement therebetween. Other configurations are alternatively possible. In the illustrated embodiment, the second spring **380** is coupled between the intermediate member **410** and the rotatable axle **420**. Specifically, the second spring **380** is coupled to a first side **420a** of the rotatable axle **420**, while the third spring **390** is coupled between a second side **420b** of the rotatable axle **420** and the reel **350**. It may be appreciated that the rotatable axle **420** may extend through an aperture **430** formed in the intermediate member **410**.

It may be appreciated that the first spring **370** and the third spring **390** may be wound in the same direction, while the second spring **380** may be wound in an opposite direction. As indicated in embodiments above, the first spring **370**, the second spring **380**, and the third spring **390** may therefore couple the reel **350**, the intermediate member **410**, and the rotatable axle **420** in a manner such that during operation of the reel assembly **340**, as the reel **350** is turned, the third spring **390** may be tensioned, which in turn drives the rotatable axle **420** in the same rotational direction as the reel **350**. This movement of the rotatable axle **420** is thus transferred to the second spring **380**, which causes rotational movement of the intermediate member **410**, which is transferred to the first spring **370**, anchored to the housing **360** by the connection member **400**. The tension applied through rotation of the reel **350** (e.g., to unwind a windable member thereon) is therefore transferred across the first spring **370**, the second spring **380**, and the third spring **390**.

In some embodiments, additional rotatable axles and intermediate members may be utilized, scaling the ability for the reel assembly to retract a windable member, without increasing the diameter of the assembly. For example, FIG. 5 illustrates an embodiment of a reel system **440** having a reel **450** configured for rotation relative to a housing **460**. The reel system **440** includes a plurality of springs **470** (specifically springs **470a-g**), a plurality of intermediate members **480** (specifically intermediate members **480a-c**), and a plurality of rotatable axles **490** (specifically rotatable axles **490a-c**). As shown, the spring **470a** couples between a connection member **500** fixed relative to (e.g., integral with) the housing **460** and the intermediate member **480a**. The spring **470b** couples between the intermediate member **480a** and the rotatable axle **490a**. The spring **470c** couples between the rotatable axle **490a** and the intermediate member **480b**. The spring **470d** couples between the intermediate member **480b** and the rotatable axle **490b**. The spring **470e** couples between the rotatable axle **490b** and the intermediate member **480c**. Such alternate couplings between the springs **470**, the intermediate members **480** and the rotatable axles **490** may continue until a terminal spring (e.g., spring **470g** in the illustrated embodiment) couples to the reel **450**. It may be appreciated that any number of intermediary members may be utilized, and that adjacent springs **470** may be wound in opposite directions to one another, as described above. Furthermore, it may be appreciated that due to space constraints, the last spring **470** may generally be coupled between the reel **450** and one of the rotatable axles **490**, however alternative configurations may be utilized depending on the configuration of the intermediate members **480**.

It may be appreciated that in some embodiments, the springs may couple to spring coupling members that share the functions of both the intermediate members and the rotatable axles, as described above. For example, FIG. 6 illustrates an embodiment of a reel system 510 including a reel 520 configured to rotate relative to a housing 530. A first spring 540 is coupled between a connection member 550 fixed relative thereto (and in the illustrated embodiment, is integral therewith) and a spring coupling member 560, described in greater detail below. A second spring 570 couples between the spring coupling member 560 and the reel 520. As shown, the spring coupling member 560 may be configured with an intermediate member 580 configured to at least partially surround the first spring 540 (potentially isolating the first spring 540 from the reel 520), and an axle portion 590 extending therefrom, which may provide a mounting surface for another spring, such as the second spring 570. It may be appreciated that the intermediate member 580 and the axle portion 590 may be fixed relative to one another, and may rotate together. In some embodiments, the intermediate member 580 and the axle portion 590 of the spring coupling member 560 may be formed integral to one another (e.g., of a one-piece construction). In some embodiments, the intermediate member 580 may have an annular configuration, and may completely encircle the spring received therein (e.g., the first spring 540). As described above, the first spring 540 and the second spring 570 (as adjacent springs in the illustrated embodiment) are configured to be wound in opposite directions. The spring coupling member 560 of the illustrated embodiment is configured to rotate about the connection member 550, by including an engaging recess 600 configured to receive a protruding end of the connection member 550. As such, rotation of the reel 520 (i.e. to release lengths of the windable member received thereon) may cause tensioning of the second spring 570, transferred to the first spring 540 through rotational motion of the spring coupling member 560. Although one spring coupling member 560 is shown in the illustrated embodiment, it may be appreciated that additional spring coupling members and associated springs may be further provided in other embodiments, so as to further scale the reel system without increasing a diameter thereof. For example, in an embodiment the engaging recess 600 of one spring coupling member 560 may receive a protruding portion of the axle portion 590 of another spring coupling member 560, each with springs operatively coupled therebetween.

As indicated above, the reel assembly may be configured so that the springs thereof have different configurations. Such a varied spring configuration may provide a variable torque profile for retraction of the windable member. For example, the variable torque profile may facilitate a faster retraction of the windable member during the initial retraction, however a slower retraction of the windable member thereafter. In an embodiment, a "primary" spring having a lower initial torque potential than the other spring(s) may rotate to become predominantly compressed, with an increasing resultant torque profile as a result of such compression. When the primary spring's torque profile exceeds the other spring(s) torque potential, a subsequent spring having the current lowest torque potential, coupled to the primary spring by rotatable members such as the rotatable axle, the intermediate member, or the spring coupling members described above, may compress, increasing the subsequent spring's torque profile. Such action across a plurality of springs may therefore create a variable torque profile for the reel assembly. Accordingly, in an embodiment an initial torque of the combined primary and subsequent springs of the reel assembly may be greater than the torque of the primary spring alone.

It may be appreciated that characteristics of each spring may vary to create an associated torque profile for that spring. For example, in an embodiment inner central axis diameters of the primary and sequential springs may differ. In an embodiment, the springs may be comprised of different material types or grades. As an example, the springs may be comprised of hot or cold rolled carbon steels, heat treated carbon spring steels, stainless steel, non-metallic composites, and/or any other appropriate material. In some embodiments, the primary spring may be connected to a fixed axis (e.g., the connection member, as described above), while the subsequent spring(s) may be connected to a non-fixed axis (e.g., the rotatable axle, the intermediate member, or the spring coupling members, as described above). In an embodiment, a cross sectional area or volume of the primary spring may be different from that of a sequential spring. In an embodiment, the springs may be of different lengths (e.g., the primary spring may be of a different length than the subsequent spring or springs). As one non-limiting example, one spring may be 80" in length, while another may be 130" in length, which may provide a combined length for the spring system of 250". Other difference between the springs of the reel assembly may also vary the torque profile of each spring and of the reel assembly as a whole, and may be implemented in other embodiments.

In some embodiments, two or more springs may be wound concentric to the same axis in alternating layers (e.g., with adjacent springs wound oppositely to one another). For example, if a first spring is 100" in length, and a second spring is 100" in length, with the first spring and the second spring (i.e., the primary springs) wound in opposite directions, then one or more additional springs (e.g., a third spring) could be coupled to the first spring and the second spring. In an example, the third spring could have a length shorter than that of the first spring and the second spring (e.g., 30" in length). The third spring may be coupled to either the first spring or the second spring, with a first end connected to the axle, and the second end not being fixed, but instead being captured between coils of the first spring or the second spring. The coupling of the third spring in this manner may be beneficial because it may add additional spring torque to the initial torque winds and profile associated with the first spring or the second spring (which generally has the lowest torque profile for a spring), and thus may create a more constant force torque profile. It may be appreciated that the third spring may in some embodiments comprise a separate spring, or in other embodiments may be formed by extending one of the primary springs to form a "tail" that may be wound back (e.g., looped or folded) over the other of the primary springs, as inter-engaging springs in alternating layers. As such, it may be appreciated that the primary springs may be of different lengths from each other, or from one or more sequential springs.

As noted above, the springs utilized in various embodiments above may be of different constructions or configurations, including but not limited to being of different material choices. It may be appreciated that the materials utilized in the reel assemblies described herein may be of different constructions or configurations in various embodiments. For example, the housing, the reel, the windable member, the springs, and/or appurtenant structures associated therewith may each be constructed from a variety of materials, including but not limited to plastic, metal, rubber, elastomer, or any other appropriate material choice.

In some embodiments, one or more of the components disclosed herein, such as the tape, the housing (and its open-

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ing), the axle, or so on, can be made in accordance with the teachings of U.S. Pat. No. 6,643,947, incorporated herein by reference in its entirety.

It may be appreciated that the teachings disclosed herein may alternatively be utilized in other contexts, with other windable materials that do not have gradations thereon. For example, the material(s) wound around the reel utilizing the teachings herein may include cables, cords, wires, ropes, tubes, twine, or any other extendable and retractable medium. Specifically, in some embodiments, the teachings disclosed herein may be extended to reels configured to house power/electrical cables, data cables (e.g., phone, network, and peripheral cables), hoses/tubes, chalk reels, fishing line, and so on.

Although the invention has been described in detail for the purpose of illustration based on what is currently considered to be the most practical and preferred embodiments, it is to be understood that such detail is solely for that purpose and that the invention is not limited to the disclosed embodiments, but, on the contrary, is intended to cover modifications and equivalent arrangements that are within the spirit and scope of the appended claims. For example, it is to be understood that the present invention contemplates that, to the extent possible, one or more features of any embodiment can be combined with one or more features of any other embodiment.

What is claimed is:

1. A measuring tape rule device comprising:

a tape rule housing, the housing having a connection portion;

an axle within the housing, the axle configured to rotate about an axis of rotation;

a reel within the housing, the reel configured to rotate about the axis of rotation and the axle;

an elongated tape having gradations thereon and wound on the reel;

a first spring coupled between the axle and the connection portion of the housing; and

a second spring coupled between the axle and the reel; wherein rotation of the reel relative to the housing in a direction tending to tension the second spring transmits rotational movement to the axle through the tensioning of the second spring, and wherein such rotational movement of the axle is applied to the first spring to tension the first spring.

2. The measuring tape rule device of claim 1, wherein the second spring has a torque profile associated therewith different from a torque profile of the first spring.

3. The measuring tape rule device of claim 1, wherein at least one of the first spring and the second spring comprises a spiral spring wound relative to the axis of rotation.

4. The measuring tape rule device of claim 3, wherein a length of the first spring is different from a length of the second spring.

5. The measuring tape rule device of claim 3, wherein a width of the first spring is different from a width of the second spring.

6. The measuring tape rule device of claim 3, wherein a cross sectional area of the first spring is different from a cross-sectional area of the second spring.

7. The measuring tape rule device of claim 1, wherein the first spring is formed from a different material than the second spring.

8. The measuring tape rule device of claim 1, wherein the first spring and the second spring are fixed to the axle.

9. The measuring tape rule device of claim 1, further comprising one or more additional springs coupled between the first spring and the second spring.

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10. The measuring tape rule device of claim 9, further comprising an intermediate member coupled between one of the one or more additional springs and the axle.

11. The measuring tape rule device of claim 10, wherein the intermediate member is configured to separate the one of the one or more additional springs from the reel.

12. The measuring tape rule device of claim 10, wherein the intermediate member has an annular configuration.

13. The measuring tape rule device of claim 10, wherein the first spring is coupled to the axle by the intermediate member and the one of the one or more additional springs.

14. The measuring tape rule device of claim 13, wherein the second spring is fixed to the axle.

15. The measuring tape rule device of claim 9, wherein adjacent ones of the first spring, the second spring, and the one or more additional springs are wound opposite to each another.

16. The measuring tape rule device of claim 1, wherein the first spring is wound opposite to the second spring.

17. The measuring tape rule device of claim 1, wherein the reel is supported adjacent to the housing.

18. The measuring tape rule device of claim 17, wherein reel is shaped to engage a flanged portion of the axle configured to prevent movement of the reel away from the axle.

19. The measuring tape rule device of claim 1, wherein the reel is enclosed by the housing.

20. The measuring tape rule device of claim 1, wherein the axle is part of a spring coupling member further comprising an intermediate member, wherein one of the first spring, the second spring, and the one or more additional springs is fixed to the axle, and another of the first spring, the second spring, and the one or more additional springs is fixed to the intermediate member, wherein the intermediate member is configured to encircle the another of the first spring, the second spring, and the one or more additional springs during rotation about the axis of rotation.

21. The measuring tape rule device of claim 20, further comprising another spring coupling member, wherein the one or more additional springs comprises a third spring, wherein the third spring is coupled between the axle of the spring coupling member and an intermediate member of the another spring coupling member.

22. The measuring tape rule device of claim 1, wherein the connection portion is integral with the main housing, or is separate from and attached to the main housing.

23. The measuring tape rule device of claim 1, further comprising one or more additional axles coupled to the first spring or the second spring by one or more additional springs.

24. The measuring tape of claim 1, wherein one or more of the first spring and the second spring is at least partially positioned outside of a volume defined by the reel.

25. A measuring tape rule device comprising:

a housing having an opening, the housing comprising a connection portion therein;

an axle within the housing, the axle being rotationally supported in the housing and configured to rotate about an axis of rotation;

a reel within the housing, the reel configured to rotate about the axis of rotation and the axle;

an elongated tape, the tape having measuring gradations thereon, the tape being wound on the reel and being extendable through the opening in the housing;

a first elongated spiral spring, the first elongated spiral spring having a first end portion and a second end portion, wherein the first end portion of the first elongated spiral spring is connected with the connection portion of

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the housing, and the second end portion of the first elongated spiral spring is connected with the axle;

- a second elongated spiral spring, the second elongated spiral spring having a first end portion and a second end portion, wherein the first end portion of the second elongated spiral spring is connected with the reel and the second end portion of the second elongated spiral spring is connected with the axle;

wherein extension of the elongated tape through the opening in the housing rotates the reel in a first direction, wherein rotation of the reel in the first direction increases tension on the second elongated spiral spring, wherein increasing tension on the second elongated spiral spring imparts rotational movement of the axle in a first rotational direction, wherein rotational movement of the axle in the first rotational direction imparts increased tension on the first elongated spiral spring; and

wherein tension in the first elongated spiral spring and the second elongated spiral spring biases the reel in a second rotational direction that retracts the tape into the housing and winds the tape onto the reel.

26. The measuring tape rule device of claim 25, wherein the first elongated spiral spring has a torque profile associated therewith different from a torque profile of the second elongated spiral spring.

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27. The measuring tape rule device of claim 25, wherein the first elongated spiral spring has a spring constant associated therewith different from a spring constant of the second elongated spiral spring.

28. The measuring tape rule device of claim 25, wherein the first elongated spiral spring has a torque profile associated therewith substantially the same as a torque profile of the second elongated spiral spring.

29. The measuring tape rule device of claim 25, wherein the first elongated spiral spring has a spring constant associated therewith substantially the same as a spring constant of the second elongated spiral spring.

30. The measuring tape rule device of claim 25, wherein the first elongated spiral spring is wound opposite to the second elongated spiral spring.

31. The measuring tape rule device of claim 25, further comprising one or more additional axles coupled to the first elongated spiral spring or the second elongated spiral spring by one or more additional springs.

32. The measuring tape rule device of claim 31, wherein adjacent ones of the first elongated spiral spring, the second elongated spiral spring, and the one or more additional springs are wound opposite to each another.

33. The measuring tape of claim 25, wherein one or more of the first elongated spiral spring and the second elongated spiral spring is at least partially positioned outside of a volume defined by the reel.

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